Motility as a biosignature in extreme environments: tracking bacterial movement and taxis in subzero brines as an analog for detecting life on icy moons. G. M. Showalter[1], J. Nadeau[2], C. Lindensmith[2,3], and J. W. Deming[1], [1]School of Oceanography, University of Washington, Seattle WA 98115, [2]California Institute of Technology, Pasadena CA 91125, [3]NASA Jet Propulsion Laboratory, Pasadena CA 91011

Swimming is a fundamental behavior of many marine bacteria, allowing them to locate optimal conditions in a sea of gradients and to colonize new environments. Understanding bacterial motility in the cold (< 5°C) marine waters that dominate our planet, and potentially within its sea ice cover, has broad implications in diverse fields, including the unambiguous detection of life in extreme environments, terrestrial and possibly extraterrestrial. Yet, bacterial motility in the cold remains largely unexplored. To help address this gap in knowledge, we are characterizing motility and taxis of the model marine psychrophilic bacterium, *Colwellia psychrerythraea* 34H (Cp34H), in response to a variety of stimuli simulating the thermal, haline, and other chemical micro-scale gradients that exist in marine environments and are accentuated in sea ice. In addition to conventional approaches, we are working with a novel digital holographic microscope (DHM) with submicron resolution, developed at JPL/Caltech for future spacecraft deployment. 3D reconstructions of DHM data show trackable paths of Cp34H grown in media of high salinity (up to 75 ppt NaCl) and also confirm motility at subzero temperatures (down to –13°C). Initial laboratory results demonstrate the ability of Cp34H to swim under simulated conditions of sea-ice brines and to demonstrate thermotaxis toward its optimum growth temperature (8–11°C). These and other results on halotaxis will establish a foundation for more targeted research on the swimming behaviors of Cp34H under extreme conditions, to further develop instrument and software needs for holographic microscopy using motility as a biosignature and inform the search for life on icy moons.